English translation of specification of European Patent No. EP 503114 Description

The invention concerns a process for producing an air-permeable, weather-fast and permanently flame-resistant awning fabric based on a weather-fast, permanently flame-resistant, differently dyed yarn - ultimately the invention concerns a yarn-dyed awning fabric that is air permeable, weather fast and permanently flame resistant.

According to EP-A-0 038 090 it has been possible to produce for the first time an air-permeable, weather-fast material on the basis of a flame-resistant basic fabric, combined with a newly developed, flame-resistant finish. Since there are no spun-dyed synthetic fibres on the market that could be used for flame-resistant awing fabrics, the process according to the aforementioned printed publication proceeds from a colourless basic fibre on a modified acrylic basis that is used to produce a crude fabric which, following the addition of the dyes, is subjected to the oil-, dirt- and grease-repelling hydrophobic process described in the printed publication. To already dye the basic fibre or include other already dyed acrylic fibres was not possible without thereby impairing weather fastness and flame resistance. Consequently, for process-technical reasons, the known product could only be produced in a single colour, particularly since finishing would have covered any previous dyeing. Furthermore the increased product weight and rigidity of the product caused by finishing would have been a hindrance in many applications.

Only tarpaulins that fulfil the demands regarding weather fastness and permanent flame resistance have been hitherto available on the market, but these are not air permeable and this results in unwanted heat build-up when they are used as awnings.

The article written by M. Peter and H.K. Ruwett "Grundlagen aus der Textileveredlung", (*"Fundamentals from the Field of Textile Finishing"*), Deutscher Fachverlag, Frankfurt, pp. 574 to 592 and p. 748, refers to a polyethylene terephthalate yarn that is treated with a flame-resistant dispersion dye. Furthermore, this printed publication discloses the possibility of using a levelling agent. However, this printed publication does not deal with the problem of combining a flame-resistant finish with a weather-fast finish where the mutual properties are not excessively impaired whilst maintaining the fabrics air permeability.

The document "Index to Textile Auxiliaries", 1988, World Textile Publications Ltd., p. 97, re Sp, reveals the suitability of fluorocarbon resin as an oil- and water-repelling coating agent for synthetic fabrics.

The purpose of the invention is to provide a textile material with which patterned awning fabrics can be produced that fulfil the requirements regarding weather fastness and permanent flame resistance and which are also air permeable. For this purpose a yarn dyeing process for a specific basic fibre had to be developed, together with dyes specifically adapted to these basic fibres, which would ensure that the existing weather fastness and permanent flame resistance are maintained. Moreover, an oil-, dirt- and grease-repelling hydrophobic finish had to be developed that would not cover the dyed colour of the basic fabric and would still ensure that the basic fabric remained air permeable. Furthermore, the finishing process for the basic fabric had to ensure that the weather-fastness and flame-resistance properties were not influenced.

The invention-conform yarn dyeing process and the finishing process are described in Claim 1 and the related sub-claims 2 to 11. Claim 12 describes an invention-conform awning fabric that can be produced with a pattern (striped) in keeping with current fashion trends and that is air permeable, weather fast and permanently flame resistant.

The invention-conform yarn dyeing method and the invention-conform finishing method are subsequently described in detail.

Yarn dyeing method

The starting point for the yarn dyeing method is a basic fibre consisting of 100% polyethylene terephtalate, such as Tevira CS® (Höchst company), which is first extruded in a colourless state, cut and then spun into yarn. The yarn is dyed with a dyeing liquor composed of

- x% (depending on type and depth of dyeing) dispersion dye, developed with regard to weather fastness and flame resistance, such as Samaron® (Höchst company), Resolin® (Bayer company) or Terasil® (Ciba company);

- 0.8 to 1.5%, especially 1% levelling agent such as Eganal PS®, to level the dye coating on the fibres;

- x% acetic acid to adjust a pH value of 4.5 to 5;

- 2% sodium acetate as an acid donor to stabilise the pH value;

- Topped up with soft water

The dry material (cross-wound bobbin with a material coating per bobbin of between 600 and 1000 g on perforated cylindrical or conical sleeves) is fore-run with water / acetic acid / sodium acetate in an autoclave under a pressure of 2 to 3.4 bar at 50°C for 15 minutes. The pH value is adjusted to 4.5 to 5. 1% Eganal PS® is added to the fore-run liquor after which the material is fore-run once again for 15 minutes at 50°C. Eganal PS® is a levelling agent which will ensure that the dye will be uniformly transferred to the yarn.

The dye is added to a separate liquor basin. The dyeing liquor is then pumped back to the autoclave. Normally operation is at a liquor ratio (by-weight relation between material and liquor) of 1:10 to 1:20. The liquor flow rate is 25 l/minute x kilogram yarn.
Example: 100 kg of yarn are dyed in 1000 ltr. of liquor. This produces a liquor ratio of 1:10. The resulting flow rate through the cross-wound bobbins is 2500 l/minute. Higher flow rates can deform the bobbins; lower flow rates give rise to the problem of fluctuations, i.e. streaks are formed in the (subsequent) fabric.

With alternating liquor circulation - i.e. the liquor is alternatively pressed through the cross-wound bobbin for 3 minutes from the outside to the inside, and then again for 2 minutes from the inside to the outside - the liquor is slowly and uniformly heated up to 80°C at a rate of 1°C/minute. Heating is stopped for 10 minutes when 80°C is reached; thereafter the liquor is heated to a temperature of 115°C at a rate of 0.8°C/minute. Dyeing is then continued at this temperature for between 30 and 60 minutes, depending on the dyeing depth. The liquor is then removed from the autoclave.

Yarn dyeing with dispersion dyes should always be followed by a cleaning process to remove residue dyes and auxiliaries. This achieves better fastness and further processing of the yarns can be simplified. A suitable cleaning bath consists of

3 ccm/l ammonia, 25% = alkaline agent
2 g/l hydrosulfite = oxidant
1 g/l Leomon OR® = detergent
Topped up with water

After the dyeing liquor has been drained off, the prepared cleaning bath is pumped into the autoclave where it is circulated for approx. 20 minutes at 60°C. This is followed by two rinses with pure water at 70°C.

Cleaning is followed by after-preparation to give the yarn certain gliding properties that will simplify further processing during winding and weaving. After-preparation is carried out with, e.g. 1.5 g Leomin AFK® / l water; the pH value is adjusted at 6 to 6.5. The lye is allowed to circulate for approx. 20 minutes at 50°C, after which the cross-wound bobbins are dried without any more rinses.

After drying and rewinding the dyed yarn is woven. The woven fabric is then washed continuously twice at 95°C in a full-width washing machine to remove dust, grease and other impurities. An appropriate washing lye contains 1 g/l Hostapel FA® and 1 g/l Calgon T®. This is followed by drying on a stenter frame at 150°C.

Finishing process

To give the woven fabric an oil-/dirt-/water-repelling finish, the dried fabric is transferred from the stenter frame through a finishing bath containing a fluorocarbon resin such as Scotchgard FC 251® (3M company) and an organic compound with a high phosphorous content such as Pekoflam PES ® (Dick Peters company). The finishing bath contains 12 g/l Scotchgard FC 251® and 72.8 g/l Pekoflam PES®. The run through the finishing bath is followed by foulard finishing and finally by continuous condensation on a stenter frame at a condensation temperature of 170°C and a dwell time of 1 minute.